

ADVANCED CONCEPT TRAINING Parameters

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Introduction

This training contains an assortment of examples on the use of parameters in SCIA Engineer.

What is the purpose of using parameters in SCIA engineer? Imagine that a SCIA Engineer user deals nearly every day with the same type of structure. Only the dimensions, cross-sections, height, number of spans, etc. differ in the projects. For such differences, parameters can be used as where in SCIA engineer the functionality 'Parameters' servers for.

Every 'version' of the same type, as mentioned in the above, can be parameterized. The parameters are fully editable and when changed they may lead to a very straightforward modification of the analysis model.

What's more, a model defined by means of parameters can be saved as a template. When opened, the user is first asked to fill in the table with all the parameters present in the model. This may be effectively used for creation of simple "programs" for e.g. calculation of continuous beam, simple frame, etc.

The user has to create the structure only once and save the structure as a template of a specific type. Then he/she only has to define the parameters for every new project, instead of creating a whole new structure from scratch each and every time. The modelling is thus only done once in the initiation of the template file and the user can immediately proceed to calculation and evaluation of results after the parameters are defined.

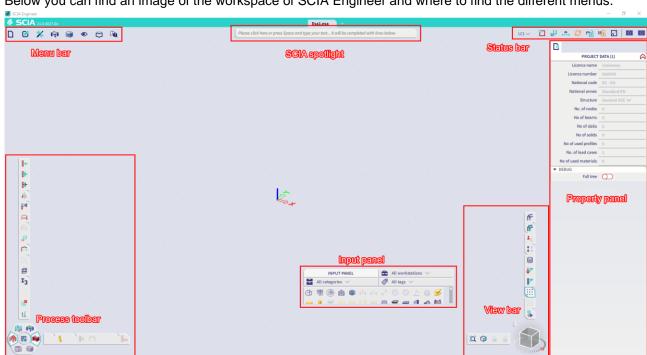
This leads to a huge reduction of the working hours on one side and a less human error sensitive approach.

Besides the above, this workshop contains also some extra's which can help the user to become more effective in working with SCIA Engineer:

- XML: one of the formats SCIA Engineer supports to export and import a project from.
- ODA: One Dialog Application
- Batch optimizer: the user can give a range of values for a parameter and the solution is also a range of results. This could be used to chose the most effective value to obtain a certain result.
- User blocks: a project can be saved as a user block together with its parameters. Afterwards, this block can be imported in another project.
- Project templates: as mentioned before, the user can make a standard project which can be used for all the other projects of the same type.

Most of the options in the course can be calculated/checked in SCIA Engineer with a license for a professional edition or the separate Parametric modelling module.

For some supplementary checks an extra module (or edition) is required, but this will always be indicated in those paragraphs.



Below you can find an image of the workspace of SCIA Engineer and where to find the different menus.

EXAMPLE 1: Beam on two supports

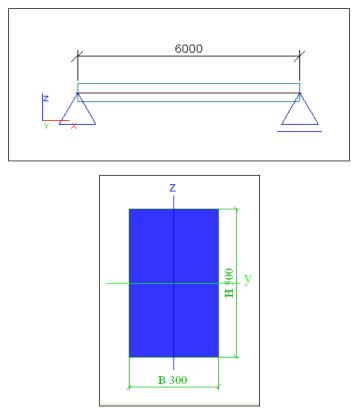
Example: "Beam parametric.esa"

We will parametrize the length and cross section dimensions of a simple concrete beam supported on two ends.

Project data:

- Structure type: frame XZ
- Materials: concrete C30/37
- Functionality: 'Parametric Input'

Create a beam with the below properties:



When starting a parametric project we are using default values for the properties we are going to parametrize later on. These can be chosen randomly.

6m for the length of the beam in this case and 500x300mm for the dimensions of the cross section.

Definition of parameters

Before being able to apply parameters in our project we have to define a list of parameters. You can do that in the library by going to "Libraries" > "Tools" > "Parameters" in the main menu.

Each parameter has a "Name", "Type" and "Description" property by default. For "Name" better use a short string because a parameter can be used in the formula for the definition of another parameter.



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L - Length		Name	L		L - Leng	th			I	Name	н	_	L - Len	gth				Name	W		
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		Description	Length		W - Heig	ht			Descri	iption	Height		W - Wie	lth			Descr	iption	Width		
		Evaluation '	Value	*					Evalu	ation	Value	~					Eval	uation	Formula		۷
		Value [m]	6,00						Value	[mm]	600,0						Fo	rmula	H/2		
		Use range							Usei	range							Value	[mm]	300,0		
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			Valida	te >>>							Validat	e >>>							Validate	>>	>
New In	sert Edit	Delete		Close	New	Inse	ert E	dit	Delete			Close	New	Ins	sert	Edit	Delete			Clos	e

Note that when defining a parameter if a certain type already a value has to be assigned. For the width we chose to apply a formula instead of a value so that the width of the beam in this case is always half the length of the height.

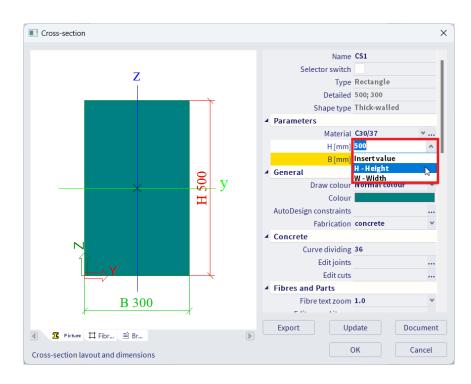
Assigning parameters

If you used the correct type for all the parameters you can simply assign a parameter to any values in the project of that type by clicking on the dropdown menu.

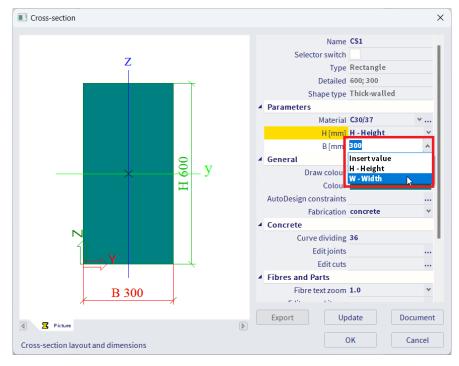
Change the X-coordinate of the end beam to parameter "L":

	✓ ✓ Ξ NODE (1) ✓ ▲	\$
	Name N2	
Ň	▼ GCS COORDINATE	
	X [m] 6	\sim
X	Z [m] 6,000 L - Length = 6,000	٦
	▼ UCS COORDINATE	_
	ux [m] 6,000	
	uz [m] 0,000	
	▼ MEMBERS	
	Member B1	

Change the height of the cross section to parameter "H":



Change the width of the cross section to parameter "W":



Note that in the actual values of the properties are now replaced width the name and description of the chosen parameters. While in the model the values of the parameters are taken into account (length of 6m, height of 600mm and width if 300mm).

Parameter template sets

Now we can define different sets of values for the parameters we created. Go to "Libraries" > "Tools" > "Parameters template set":

Edit parameter set						×					
Parameter set			ake un foi	the geo	metry						
Set description:	Use 3D pre	Definition of the parameters that make up for the geometry.									
Available para	ameters		S	elected p	aramete	ers					
Name unit typ	be		Name	unit	type						
		Add selected	L H								
		Add all									
		Remove all									
		Remove									
		Insert group									
		Remove group									
		Rename group									
				ОК		Cancel					

You can for example have one set for the geometry, one set for the loads, one set for stiffnesses of the supports etc. In this case we added all parameters to the "Geometry" set with "Add all" button.

Valuate parameters

Each set of parameters can now be changed via the template manager: "File" > "Template manager" in the main menu:

Project	×
Geometry	
L - Length [m] 3,00 H - Height [mm] 600,0	SAMPLE PICTURE
Refresh P P	
	OK Cancel Apply

Use the "Refresh" button to update the preview window to see the effect of the changements.

In the template manager you can also save and load different sets of parameter values for each template:

Project	×
Geometry	
L - Length [m] 5,00 H - Height [mm] 600,0	SAMPLE PICTURE
Refresh	
	ок Салсеі Арріу

EXAMPLE 2: Cross-sections

Example: "Cross-sections parametric.esa"

You can start this exercise from where you ended the previous one ("Beam parametric.esa").

General cross-section

We are going to create two additional parameters which we are going to use for creating a general cross section. In the main menu go to "Libraries" > "Tool" > "Parameters" and create the below parameters:

Parameters		×	Parameters		×
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L - Length		Name H1	L - Length		Name B1
H - Height		Type Csslength 👻	H - Height		Type Csslength 🗸
W - Width		Description Height General CS	W - Width		Description Width General CS
H1 - Height General CS		Evaluation Value	H1 - Height General CS		Evaluation Value
B1 - Width General CS		Value [mm] 600,0	B1 - Width General CS		Value [mm] 400,0
		Use range			Use range
	Actions			Actions	
		Validate >>>			Validate >>>
New Insert Edit	Delete	Close	New Insert Edit	Delete	Close

Note that each name has to be unique so better also add a clear description for each parameter.

As opposed to a standard library cross section, for general cross sections parameters can't be assigned directly to properties. In the project create a new general cross section and that there is a parameter setting in the general editor itself:

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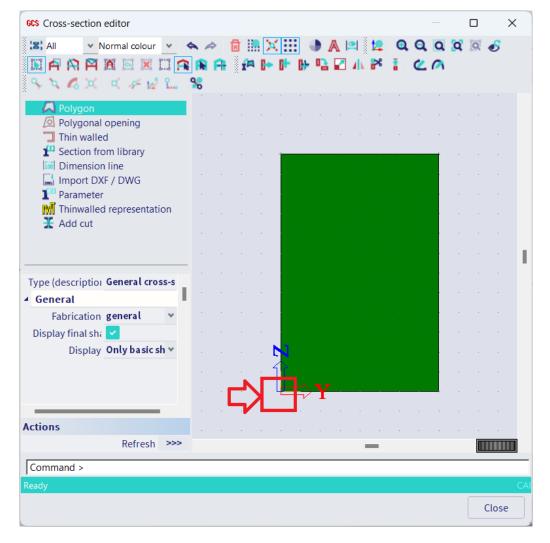
Click on it and define a parameter for the width and the height as we are going the make a (general) rectangular cross section:

Parameters		×	Paramete	rs			×
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H1 - Height General CS	Name	H1	H1 - Height Ge	eneral CS	Name	W1	
W1 - Width General CS	Туре	Csslength	W1 - Width Ge	eneral CS	Туре	Csslength	
	Description	Height General CS			Description	Width General C	:s
	Export to properties of cross	~			Export to properties of cros	~	
	Evaluation	Value 🗸			Evaluation	Value	~
	Value [mm]	600,0			Value [mm]	400,0	
	Use range				Use range	• 📃	
	Actions				Actions		
		Validate >>>				Validate	>>>
New Insert Edit	Delete	Close	New Inse	rt Edit	Delete	CI	lose

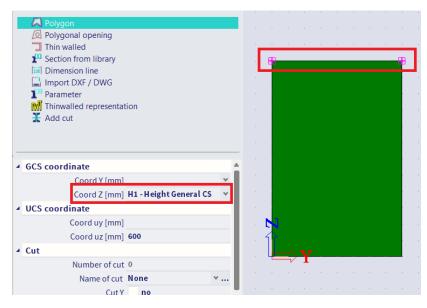
Make sure to enable the "Export properties of cross section".

We chose for the exact same naming as we did in the first step when defining the parameters of the project. Because that way we can easily assign the "general cross section parameters" to the parameters defined in the project, see below.

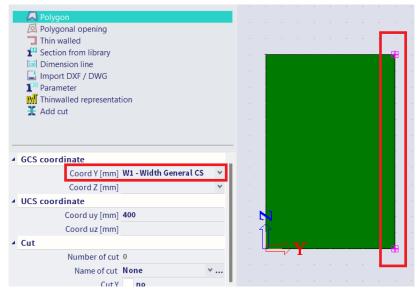
Now create a random rectangle with the "Polygon" option, but start in the origin of the editor window:



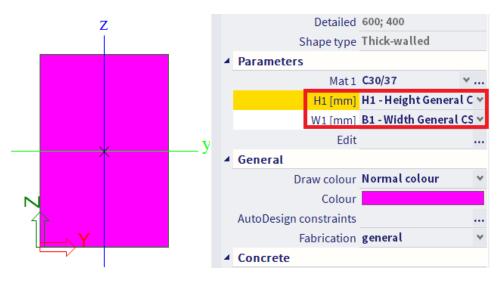
Then select the top two nodes and assign H1 to "Z":



And select the right hand side two nodes and assign W1 to "Y":



Close the window with "Close" and in the next window we can assign the parameters of the project to the parameters of the general cross section:



We can now also create a separate set of parameters for the general cross section. Go to "Libraries" > "Tools" > "Parameters template set" and add a new set:

Parameter set	×	
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Recometry Secometry Use 3D preview Use 3D preview Check page Info Definition of the pa Picture Icon Code Name Branch Level 1 Branch Level 2 Branch Level 3 Parameters I H New Insert Edit Delete	Edit parameter set Parameter set General cross sect Set description: Use 3D preview Check page Available parameters Name unit type H L	Selected parameters Name unit type Add selected Add all Remove all Remove group Rename group
		OK Cancel

For each set there is a different tab in the template manager:

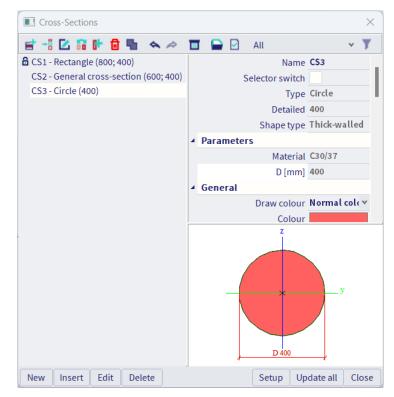
Project	×
Geometry General cross section	
B1 - Width General CS [mm] 400,0 H1 - Height General CS [mm] 600,0	SAMPLE PICTURE
Refresh 🔐	1
X	

Cross sections as parameter

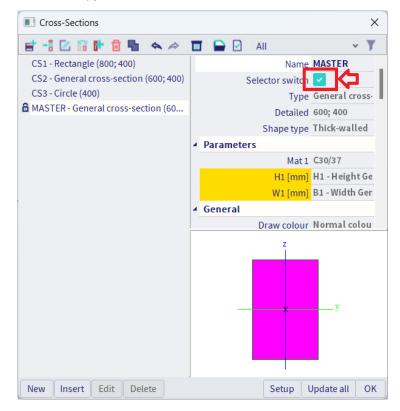
In SCIA Engineer it's also possible to parameterize libraries. Such as: materials, cross-sections, reinforcement, subsoils,...

In this topic, we will explain it for the cross-sections library. The other library types can be handled in the same manner.

Create one additional circular cross section in the project with a diameter of 400mm, this is how the cross section library should look now:



We are going to use cross sections as parameters, for this we need one master cross section which is fictive and will serve as the "selector". Copy the first cross section in the list and enable the "selector" switch:



With this option enabled we can now go to the parameters window ("Libraries" > "Tools" > "Parameters") and add a cross section parameter with the below properties:

Parameters				\times
📑 📲 🗹 🕩 🖬	All		• T	
L - Length		Name	CSS	
H - Height		Туре	Library	~
W - Width		Description	Cross sectio	n list
H1 - Height General CS		Library	Cross-Sectio	ns 🗸
B1 - Width General CS	1	Value	MASTER - Ge	eneral 🗸
CSS - Cross section list		Alternative	CS2 - Genera	l cross 🗸
		Select Alternatives		
		Alternative no. 1	CS1	
		Alternative no. 2	CS2	
		Alternative no. 3	CS3	
	Actions			
			Validat	te >>>
New Insert Edit	Delete			Close

Under "Select Alternatives" you can select the alternatives for this parameter using the SHIFT button to select multiple cross sections.

The cross section chose under "Alternative" will then be the applied cross section.

Lastly apply the CSS parameter to a 1D element in the project, you chose the cross section which we named MASER in one of the previous steps:

8	
1D MEI	MBER (1)
套 I] 🗾 🖉 💕	
Name	B1
Layer	Layer1 \checkmark
Туре	beam (80) 🗸 🗸
Analysis model	Standard \checkmark
FEM type	standard 🗸 🗸
Cross-section α Member system-line at	MASTER - General cross-sectior \checkmark \blacksquare CS1 - Rectangle (800; 400) CS2 - General cross-section (600; 40 CS3 - Circle (400)
ez [mm]	MASTER - General cross-section (60
LCS	standard 🗸 🗸

We can add this parameter also to a parameters template set:

Parameter set	×	
<mark>E -: 🖸 🕩 🖻 🐟 🗢 🗖 🕞 </mark>	u ~ T	
Geometry General cross section	Edit parameter set	×
Name General cross se Use 3D preview		Selected parameters Name unit type CSS
New Insert Edit Delete		
		OK Cancel

And switch between cross sections in the template manager ("File" > "Template manager") from the main menu:

Project	×
Geometry General cross section CSS list	
CSS - Cross section list MASTER - Circle (400) - CS3 - Circle (400)	
Refresh A	
× →	
[Q] Q) ⊉ \$ \$ \$	
OK Cancel Apply	5

EXAMPLE 3: catalogue block

Example: " Catalogue block parametric.esa"

We will parametrize the length and cross section dimensions of a simple concrete beam supported on two ends.

Project data:

- Structure type: frame XYZ
- Materials: concrete C30/37
- Functionality: 'Parametric Input'

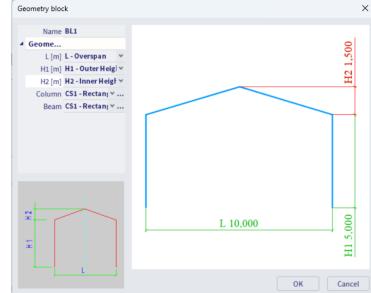
Parameters

• Create the following list of parameters by going to "Library" > "Tools" > "Parameters":

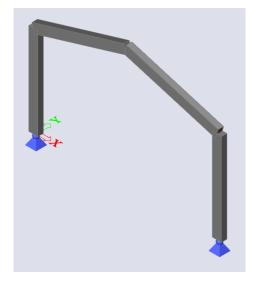
Parameters			×
📑 📲 🔀 📴 🔒 🔠		~ T	
L - Overspan	Name	L	
H1 - Outer Height	Туре	Length	
H2 - Inner Height	Description	Overspan	
Htot - Total Height	Evaluation		
Lmid - Total Height	Value [m]	10.00	
	Use range		
	oserange		
L - Overspan	Name	H1	
H1 - Outer Height	Туре	Length	
H2 - Inner Height	Description	Outer Height	
Htot - Total Height	Evaluation		
Lmid - Total Height	Value [m]	5,00	
	Use range		
	overange		
L - Overspan	Name	H2	
H1 - Outer Height	Туре	Length	
H2 - Inner Height	Description	Inner Height	
Htot - Total Height	Evaluation	Value	
Lmid - Total Height	Value [m]	1,50	
	Use range		
L - Overspan	Name	Htot	
H1 - Outer Height	Туре	Length	
H2 - Inner Height	Description	Total Height	
Htot - Total Height	Evaluation	Formula	
Lmid - Total Height	Formula	H1+H2	
	Value [m]	6,50	
	Use range		
L - Overspan	Name		
H1 - Outer Height H2 - Inner Height		Length	
Htot - Total Height		Middle Length	
Lmid - Middle Length	Evaluation		
enne mindare cengui	Formula		
	Value [m]	5,00	
	Use range		

Close the window and click on "yes" in the next pop-up window to validate values that are calculated based on the formula's we chose.

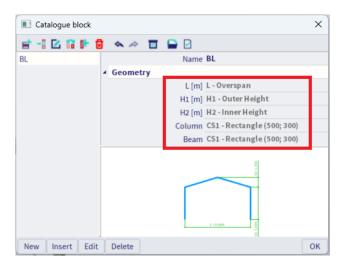
• Filter the input panel "categories" filter on "Import & Blocks" and chose for "Catalogue blocks". Under "Frame 2D" in "Available groups" chose the first Catalogue block, add a rectangular cross section and click on "OK". Assign the above parameters as shown below:



• Input the frame on coordinates "0 0 0" and add hinged supports on the bottom of the columns:



Anytime the parameters are changed in the project, the dimensions of the block will change along and you can insert a new block in the project with those new parameters:



• We want a grid now that changes along with the parameters so we can quickly see what block was inserted. Filter the input "Categories" filter on "Grids & Storeys", chose for "3D line grid" and assign the below parameters to define a parametric grid:

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IR X [M]						DIR Y [M]		C	0		DIR	Z [M]	[0	02	\$	¢
ype		Spa	n v			Туре		Spa	1	~	Тур			Span	~	
Na	me X[n] dx[n	n] Rep	s	L	Name	Y[m]	dy [m]	Rep	SL		Name	Z [m]	dz[m] Re	p S	L
1 A	0,000			no	*	1 1	0,000			no v	1	a	0,000		no	*
2 B	5,000	Lmid	~ 1	no	*		0,000	0,000 ~ 1	0	*	2	b	5,000	H1 ¥ 1	no	*
3 C	10,00	0 Lmid	. ~ 1	no	*						3	c	6,500	H2-I. ¥ 1	no	*
*	0,000	0,000	¥ 0		*						*		0,000	0,000 ~ 0		~
Gener	ate name a	utomatic	ally			Generate n	ame aut	omatically				enerate r	name aut	omatically		
Gener	ate name a	utomatica	auy			Generate n	ame auto	SmauCally				enerater	name auto	omatically		
								Rota	tion	0,00	deg			Refresh names		

EXAMPLE 4: plate on subsoil

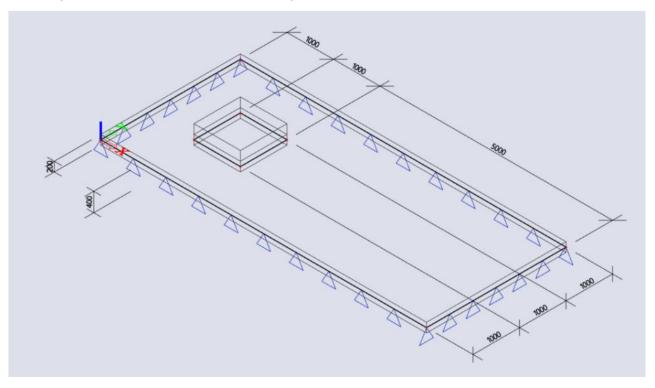
Example: "Subsoil plate parametric.esa"

We will parametrize the length and cross section dimensions of a simple concrete beam supported on two ends.

Project data:

- Structure type: general XYZ
- Materials: concrete C30/37
- Functionality: 'Parametric Input'

Create a plate on a subsoil with the below initial parameters:



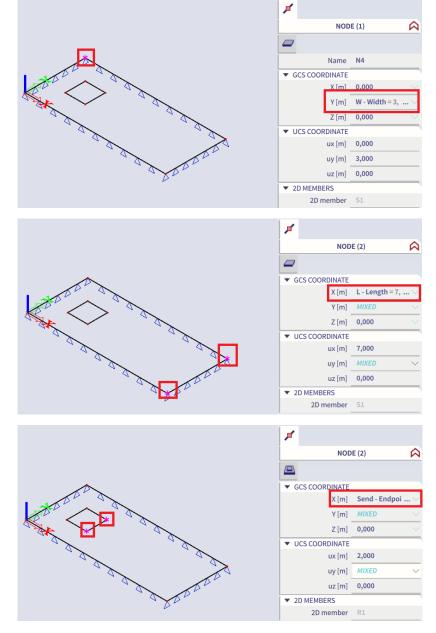


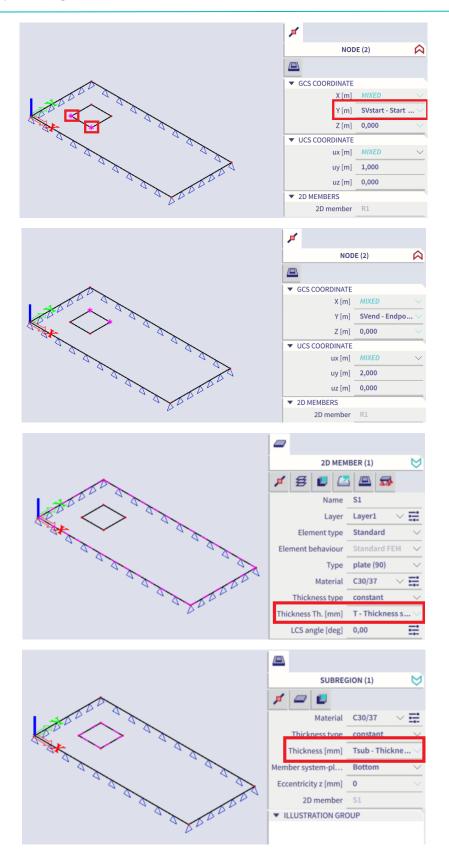


Go to "Libraries" > "Tools" > "Parameters template set" and add one set for geometrical parameters and one set for load parameters:

Parameter set	×	Parameter set	×
📑 📲 📴 🎼 🖨 🐟 🛷 🛅 🖨 🖸 All	~ T	📑 📲 🔀 🕼 🚖 🗢 🗃 🖨 🖸 🗛	× T
Geometry ParamSet		ParamSet	
 ▶ Parameters ▶ W ▶ T ▶ Tsub ▶ Ssub ▶ Sstart ▶ L 		Code Name Branch Level 1 Branch Level 2 Branch Level 3 Parameters P P P S	
New Insert Edit Delete	Close	New Insert Edit Delete	Close

• Now assign the parameters to the proper properties in the model as shown below:





- 1 🚽 📇 🧭 👈 睮 🖬 🔳 🙈 ΡN 2,0 SURFACE LOAD ON 2D (1) \boldsymbol{r} ... Direction Z Туре Force Value [kN/m^2] P - Load on pla.. 2D member Load case P - Self w ... V GEOMETRY System LCS Location L, പ്പ വ ____ C Mi 👬 🖸 Q SURFACE LOAD ON 2D (1) Ø **1**≣ Direction Z Туре Force Value [kN/m^2] Ps - Load on s Load case Q ≣ ▼ GEOMETRY System LCS Location Length ▼ ILLUSTRATION GROUP
- Also add a surface load on the slab in different load cases and subregion and make the value parametric as shown below:

• Save the project and afterwards the project is parametrized via "File" > "Template manager" from the main menu.

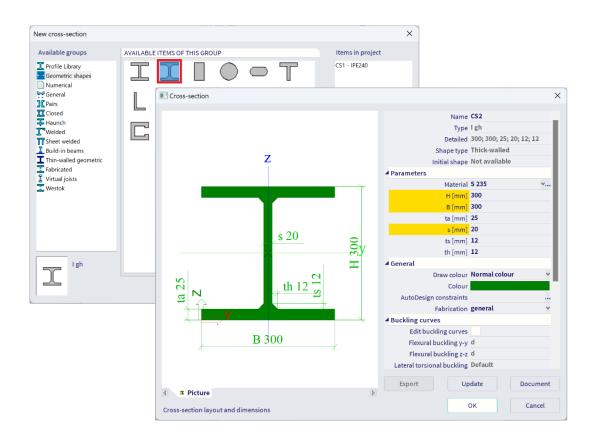
EXAMPLE 5: Cellular beam

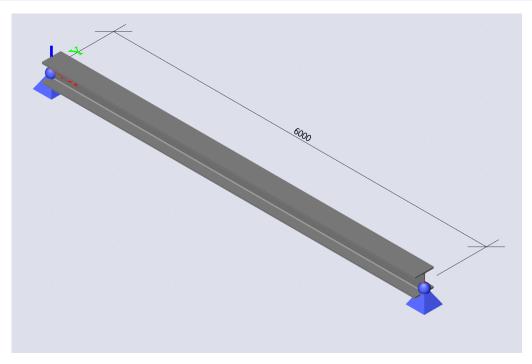
Example: "Cellular beam parametric.esa"

Project data:

- Structure type: general XYZ
- Materials: steel S235
- Functionality: 'Parametric Input'

Create a beam with the below initial properties:



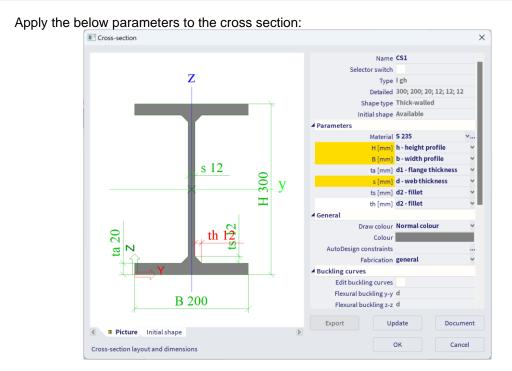


• Go to "Libraries" > "Tools" > "Parameters" and add the below parameters:

Parameters			× Parameters		×
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h - height profile	Name	h	h - height profile	Name	L .
b - width profile		Css length	 b - width profile 		Length
d - web thickness		height profile	d - web thickness		Length beam
d1 - flange thickness			d1 - flange thickness		
d2 - fillet	Evaluation		d2 - fillet	Evaluation	
L - Length beam	Value [mm]	300,0	L - Length beam	Value [m]	6,00
D - Diameter borehole	Use range		D - Diameter borehole	Use range	
x - start borehole			x - start borehole		
a - amount of boreholes	Actions		a - amount of boreholes	Actions	
dx - distance between boreholes		Validate	>>> dx - distance between boreholes	;	Validate >>
New Insert Edit Delete		Clo	se New Insert Edit Delet	te	Close
Parameters			X Parameters		×
📑 📲 🔀 📴 🖬 🛛 All	× T				
			📑 📲 🔽 📴 🕅 All	~ T	
h - height profile	Name		h - height profile	Name	D
b - width profile		Css length	 b - width profile 	Туре	Css length
d - web thickness	Description	width profile	d - web thickness	Description	Diameter borehole
d1 - flange thickness	Evaluation	Value	d1 - flange thickness	Evaluation	Value
d2 - fillet	Value [mm]	200,0	d2 - fillet	Value [mm]	150.0
L - Length beam D - Diameter borehole	Use range		L - Length beam	Use range	
x - start borehole			D - Diameter borehole x - start borehole	oserange	
a - amount of boreholes	Actions			Actions	
a - amount of boreholes dx - distance between boreholes	Actions	Validate	 a - amount of boreholes dx - distance between boreholes 	Actions	
					Validate >>>
New Insert Edit Delete		Clo	se New Insert Edit Delet	e	Close
Parameters			× Parameters		×
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h - height profile	Name	d	h - height profile	Name	x
b - width profile	Туре	Css length	✓ b - width profile		Length
d - web thickness	Description	web thickness	d - web thickness		start borehole
d1 - flange thickness	Evaluation		d1 - flange thickness		
d2 - fillet			d2 - fillet	Evaluation	
L - Length beam	Value [mm]	12,0	L - Length beam	Value [m]	
D - Diameter borehole	Use range		D - Diameter borehole	Use range	e 🔽
x - start borehole			x - start borehole	▲ Range	
a - amount of boreholes	Actions		a - amount of boreholes	Mimum Evaluatio	Value
dx - distance between boreholes		Validate	>>> dx - distance between boreholes	Minimum [m]	0,00
New Insert Edit Delete		Clo	se	Maximum Evalua	Formula
				Maximum Formu	
Parameters			×	Maximum [m]	
📑 📲 🔀 📴 🗖 🛛 All	× T				2,00
h - height profile	Name	d1	-	Actions	
b - width profile					Validate >>
	Type	Css length	New Insert Edit Delet		
d - web thickness			New Insert Edit Delet	e	Close
d - web thickness d1 - flange thickness		flange thickness	New Insert Edit Delet	e	Close
d1 - flange thickness	Description Evaluation		New Insert Edit Delet	e	Close
d1 - flange thickness d2 - fillet		Value	Parameters		
d1 - flange thickness d2 - fillet L - Length beam	Evaluation	Value	Parameters	× y	×
d1 - flange thickness	Evaluation Value [mm]	Value	 ✓ I Parameters I → I ▲ I ▲ All h - height profile 	V Y Name	a
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole	Evaluation Value [mm]	Value	 Parameters Parameters Parameters All h - height profile b - width profile 	V Y Name Type	× a h Integer
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole	Evaluation Value [mm] Use range	Value	 Parameters Parameters All h - height profile b - width profile d - web thickness 	V Y Name Type	a
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes	Evaluation Value [mm] Use range	Value 20,0 Validate	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness 	V Y Name Type	a Integer amount of boreholes
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes	Evaluation Value [mm] Use range	Value 20,0	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness 	Vame Type Description	a Integer amount of boreholes Value
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete	Evaluation Value [mm] Use range	Value 20,0 Validate Clo	 Parameters Parameters	✓ ▼ Name Type Description Evaluation	× a Integer amount of boreholes Value 6
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete	Evaluation Value [mm] Use range	Value 20,0 Validate Clo	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole 	Name Type Description Evaluation Value Use range	× a Integer amount of boreholes Value 6
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete	Evaluation Value [mm] Use range	Value 20,0 Validate Clo	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes 	Name Type Description Evaluation Value Use range	× a Integer amount of boreholes Value 6
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete ■ Parameters ■	Evaluation Value [mm] Use range Actions	Value 20,0 Validate Clo	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes 	Name Type Description Evaluation Value Use range	× a Integer amount of boreholes Value 6
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete Parameters 	Evaluation Value [mm] Use range Actions	Value 20,0 Validate Clo d2 Css length	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes 	Name Type Description Evaluation Value Use range	× a Integer amount of boreholes Value 6
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness	Evaluation Value [mm] Use range Actions	Value 20,0 Validate Clo d2 Css length fillet	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete 	Name Type Description Evaluation Value Use range	× a a integer amount of boreholes Value 6 Validate >> Close
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete Parameters Parameters C C C C C C C C C C C C C C C C C C C	Evaluation Value [mm] Use range Actions Name Type Description Evaluation	Value 20,0 Validate Clo d2 Css length fillet Value	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole a - amount of boreholes dx - distance between boreholes Mew Insert Edit Delet Parameters 	Name Type Description Evaluation Value Use range	× a Integer amount of boreholes Value 6
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete ■ Parameters ■	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm]	Value 20,0 Validate Clo d2 Css length fillet Value	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete 	Name Type Description Evaluation Value Use range	× a a integer amount of boreholes Value 6 Validate >> Close
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete ■ Parameters ■	Evaluation Value [mm] Use range Actions Name Type Description Evaluation	Value 20,0 Validate Clo d2 Css length fillet Value	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole a - amount of boreholes dx - distance between boreholes Mew Insert Edit Delet Parameters 	Name Type Description Evaluation Value Use range	× a a Integer amount of boreholes Value 6 Validate >> Close ×
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start boreholes dx - distance between boreholes Mew Insert Edit Delete Parameters E - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm] Use range	Value 20,0 Validate Clo d2 Css length fillet Value	 Parameters Parameters Parameters All h - height profile b - width profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole a - amount of boreholes dx - distance between boreholes Mew Insert Edit Delet Parameters Parameters All 	Name Type Description Evaluation Value Use range Actions te Name	× a a Integer amount of boreholes Value 6 Validate >> Close ×
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete Parameters - Parameters - Parameters - All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm]	Value 20,0 Validate Validate Clo d2 Css length fillet Value 12,0	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes dx - distance between boreholes Mew Insert Edit Delet Parameters B - S C S - All h - height profile b - width profile d - web thickness 	Name Type Description Evaluation Value Use range Actions te Name Type	a a Integer amount of boreholes Value 6 Close X dx Length
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start boreholes dx - distance between boreholes Mew Insert Edit Delete Parameters E - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm] Use range	Value 20,0 Validate Clo d2 Css length fillet Value	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes dx - distance between boreholes Mew Insert Edit Delet Parameters B - S C S - All h - height profile b - width profile d - web thickness 	Name Type Description Evaluation Value Use range Actions te Name Type Description	a a Integer amount of boreholes Value 6 4 Validate >> Close X dx Length distance between boreholes
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete Parameters - Parameters - Parameters - All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm] Use range Actions	Value 20,0 Validate Validate Clo d2 Css length fillet Value 12,0	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes dx - distance between boreholes dx - distance between boreholes Mew Insert Edit Delet Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d1 - flange thickness 	Name Type Description Evaluation Value Use range Actions te Name Type Description Evaluation	a a Integer amount of boreholes Value 6 6 Validate >> Close X dx Length distance between boreholes Formula
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete ■ Parameters ■	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm] Use range Actions	Value 20,0 Validate Clo d2 Css length fillet Value 12,0 Validate	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes dx - distance between boreholes dx - distance between boreholes Mew Insert Edit Delet Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d1 - flange thickness 	Name Type Description Evaluation Value Use range Actions te Name Type Description Evaluation	a a Integer amount of boreholes Value 6 4 Validate >> Close X dx Length distance between boreholes
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete ■ Parameters ■ -: E All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm] Use range Actions	Value 20,0 Validate Clo d2 Css length fillet Value 12,0 Validate	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes Mew Insert Edit Delet Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet 	Name Type Description Evaluation Value Use range Actions te Name Type Description Evaluation	<pre>x a a Integer amount of boreholes Value 6 6 Validate >> Close X dx Length distance between boreholes Formula (L-2*x)/(a-1)</pre>
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete ■ Parameters ■ -: E All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm] Use range Actions	Value 20,0 Validate Clo d2 Css length fillet Value 12,0 Validate	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter boreholes dx - distance between boreholes dx - distance between boreholes Mew Insert Edit Delett Parameters Parameters All h - height profile b - width profile b - width profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam 	Actions Actions Evaluation Value Use range	<pre>x a a Integer amount of boreholes Value 6 c Validate >> Close k dx Length distance between boreholes Formula (L-2*x)/(a-1) 1,14</pre>
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete Parameters Parameters 	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm] Use range Actions	Value 20,0 Validate Clo d2 Css length fillet Value 12,0 Validate	 Parameters Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter boreholes A - distance between boreholes Mew Insert Edit Delet Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole 	Actions Actions Type Description Evaluation Value Use range Actions	<pre>x a a Integer amount of boreholes Value 6 c Validate >> Close k dx Length distance between boreholes Formula (L-2*x)/(a-1) 1,14</pre>
d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes New Insert Edit Delete ■ Parameters ■ -: E All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter borehole x - start borehole a - amount of boreholes dx - distance between boreholes	Evaluation Value [mm] Use range Actions Name Type Description Evaluation Value [mm] Use range Actions	Value 20,0 Validate Clo d2 Css length fillet Value 12,0 Validate	 Parameters Parameters All h - height profile b - width profile d - web thickness d1 - flange thickness d2 - fillet L - Length beam D - Diameter boreholes dx - distance between borehole x - start borehole 	Actions Actions	<pre>x a a Integer amount of boreholes Value 6 c Validate >> Close k dx Length distance between boreholes Formula (L-2*x)/(a-1) 1,14</pre>

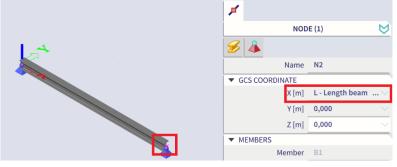
New Insert Edit Delete

Close



• And parametrize the length of the beam:

•



• Set the input panel "Categories" filter to "1D member" and chose for "Opening on 1D". Apply the below parameters in the dialogue, click on "OK" and select the beam.

Member1D opening						
ez	Name Shape	OM1 Circular			~	
Bx xa	Circular	D. Diamatas h	avahala			
	Diameter [mm] D - Diameter borehole No of edges 20					
$x^{(n-1) \times \Delta x}$	▲ Position y/z					
	Alignment	Centre			~	
	Perp.offset [mm]	0			~	
	Orientation	γ			~	
	Beta [deg]	0,00				
	Depth	Full			~	
	Calculation					
	Geometry					
	Coord. definition	Abso			~	
	Position x [m]	x - start boreh	ole		~	
	Origin	From start			~	
	Repeat (n)	a - amount of boreholes				
	Regularly					
	Delta x [m]	dx - distance b	etween bor	eholes	~	
			ок	Cance	l	

• Go to "Libraries" > "Tools" > "Parameters template set" and make a set of parameters for the cross section, the geometry and the web openings:

Parameter set		
et -: 🖸 🕩 f	🗟 🐟 🗢 🛅 🚘 🖸 All 🛛 👻 🍸	
Profile		
Geometry		
Web openings		
Name	Profile	
Use 3D preview	✓	
Check page		
Info		
Picture		
Icon		
Code Name		
Branch Level 1		
Branch Level 2		
Branch Level 3		
Parameters		
▷ b		
⊳d		
▷ d1		
▷ d2		
▷ h		
New Insert	Edit Delete	Clo

Enable 3D preview. Afterwards you can go to "File" > "Template manager" to change parameters and have a preview of the adjustments:

Project	×
Profile Geometry Web openings	
a - amount of boreholes 3 D - Diameter borehole [mm] 150,0 x - start borehole [m] 0,15	SAMPLE PICTURE
Refresh 📍 🎇	1
-	
	OK Cancel Apply

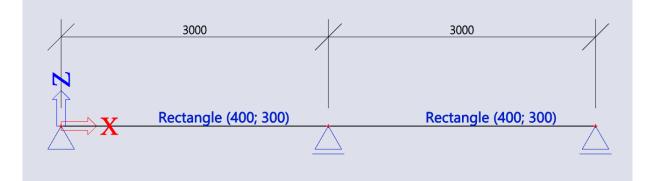
EXAMPLE 6: Reinforcement on beam

Example: "Reinforcement beam parametric.esa"

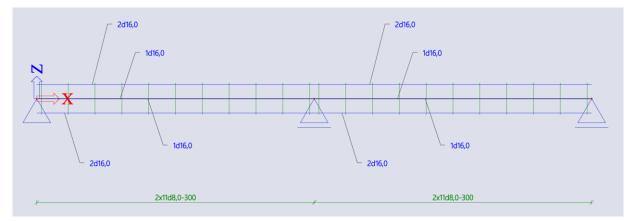
Project data:

- Structure type: Frame XZ
- Materials: Concrete C30/37
- Functionality: 'Parametric Input'

Create a multispan beam with the below initial properties:



Type "reinforcement on whole beam" in the Scia Spotlight and add some reinforcement bars on the beam with the below scheme:



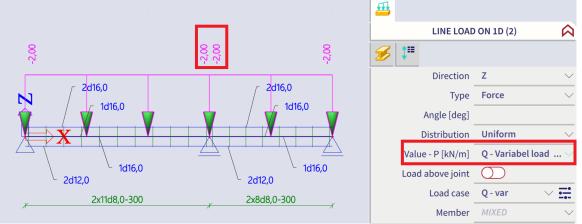
	0
D	
6	

 Go to "Librarie 	es" > "Tools" > "Parame	eters" and	add the foll	owing parar	meters to the m	odel:
Parameters		×	Parameters			×
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H - Cross section height	Name H		H - Cross section	_	Name Q	
W - Cross section width	Type Css length		W - Cross section	-	Type Li	ne load
L1 - First span	Description Cross section I	noight	L1 - First span		Description Va	
L2 - Second span	Evaluation Value	v	L2 - Second span		Evaluation Va	
Ltot - Length beam		ľ	Ltot - Length beam			
Q - Variabel load	Value [mm] 400,0		Q - Variabel load		Value [kN/m] -2	,00
Dtop - Diameter top bar	Use range		Dtop - Diameter to	op bar	Use range	
Dbot - Diameter bottom bar			Dbot - Diameter b			
Ds - Stirrup diameter	Actions		Ds - Stirrup diame		Actions	
Sdist - Stirrup distance		Validate >>>	Sdist - Stirrup dist	tance		Validate >>>
New Insert Edit Delete		Close	New Insert	Edit Delete		Close
Parameters		×	Parameters			×
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H - Cross section height	Name W		H - Cross section	height	Name D	сор
W - Cross section width	Type Css length		W - Cross section	width	Type Re	einforcement diamet
L1 - First span	Description Cross section	width	L1 - First span			iameter top bar
L2 - Second span	Evaluation Value	v	L2 - Second span		Evaluation Va	
Ltot - Length beam	Value [mm] 300,0		Ltot - Length bea	m	Value [mm] 16	
Q - Variabel load			Q - Variabel load			,-
Dtop - Diameter top bar	Use range		Dtop - Diameter t		Use range	
Dbot - Diameter bottom bar	Actions		Dbot - Diameter b			
Ds - Stirrup diameter	Actions		Ds - Stirrup diame		Actions	
Sdist - Stirrup distance		Validate >>>	Sdist - Stirrup dis			Validate >>>
New Insert Edit Delete		Close	New Insert	Edit Delete		Close
Parameters	_	×	Parameters	-	_	X
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H - Cross section height	Name L1		H - Cross section	height	Name Dt	ot
W - Cross section width	Type Length		W - Cross section	width	Type Re	einforcement diamet
L1 - First span	Description First span		L1 - First span		Description Di	ameter bottom bar
L2 - Second span	Evaluation Value	~	L2 - Second span		Evaluation Va	
Ltot - Length beam	Value [m] 3,00		Ltot - Length bear	n	Value [mm] 12	.0
Q - Variabel load	Use range		Q - Variabel load		Use range	·
Dtop - Diameter top bar Dbot - Diameter bottom bar			Dtop - Diameter to		oserunge	
Ds - Stirrup diameter	Actions		Dbot - Diameter b Ds - Stirrup diame		Actions	
Sdist - Stirrup distance		Validate >>>	Sdist - Stirrup dist		Actions	MARKED AND
New Insert Edit Delete		Close	New Insert	Edit Delete		Validate >>> Close
Parameters		×	Parameters	Luit Delete		×
	× T	~		All	v T	
			H - Cross section	-		
H - Cross section height W - Cross section width	Name L2		W - Cross section		Name Ds	
L1 - First span	Type Length		L1 - First span	wiath		inforcement diame
L2 - Second span	Description Second span		L2 - Second span		Description St	irrup diameter
Ltot - Length beam	Evaluation Value	~	Ltot - Length bear	n	Evaluation Va	lue 🗸 🗸
Q - Variabel load	Value [m] 2,00		Q - Variabel load		Value [mm] 8,	5
Dtop - Diameter top bar	Use range		Dtop - Diameter to	op bar	Use range	
Dbot - Diameter bottom bar			Dbot - Diameter b	ottom bar		
Ds - Stirrup diameter	Actions		Ds - Stirrup diame	eter	Actions	
Sdist - Stirrup distance		Validate >>>	Sdist - Stirrup dist	ance		Validate >>>
New Insert Edit Delete		Close	New Insert	Edit Delete		Close
Parameters		×	Parameters			×
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H - Cross section height	Name Ltot		H - Cross section I	neight	Name Sd	list
W - Cross section width	Type Length		W - Cross section	-	Type Le	
L1 - First span	Description Length beam		L1 - First span		Description St	
L2 - Second span			L2 - Second span		· · · · · · · · · · · · · · · · · · ·	
Ltot - Length beam	Evaluation Formula	~	Ltot - Length bear	n	Evaluation Va	
Q - Variabel load	Formula L1+L2		Q - Variabel load		Value [m] 0, 3	30
Dtop - Diameter top bar	Value [m] 5,00		Dtop - Diameter to	op bar	Use range	
Dbot - Diameter bottom bar	Use range		Dbot - Diameter b	ottom bar		
Ds - Stirrup diameter	Actions		Ds - Stirrup diame		Actions	
Sdist - Stirrup distance		Validate >>>	Sdist - Stirrup dist	ance		Validate >>>
New Insert Edit Delete		Close	New Insert	Edit Delete		Close

• Select the properties of the elements in the model and assign the corresponding parameters:







 Go to "Libraries" > "Tools" > "Parameters template set" and create a set for the geometry, cross section, reinforcement and the loads. They are now changeable in the project template settings under "File" > "Template manager":

Geometry Cross section Reinforcement Loads					
L1 - First span [m] 3,00	H - Cross section height [mm] 400,0	Dbot - Diameter bottom bar [mr 12,0	Q - Variabel load [kN/m] -2,00		
L2 - Second span [m] 2,00	W - Cross section width [mm] 300,0	Ds - Stirrup diameter [mm] 8,0			
		Dtop - Diameter top bar [mm] 16,0			
		Sdist - Stirrup distance [m] 0,30			

• Save the project as a template. You simply do this by saving the project in the template folder. By default this should be:

C:\Users*YOURUSERNAME* \Documents\ESA*XX.X*\Templates Or check the location here in the global UI settings:

Global UI settings							
Environment Templates & directories	Other Debugging tools						
TEMPLATES							
Print picture path	aphicTemplates\A4_Portrait_SciaLogo.epd						
Overview drawings manager	C:\Users\martijn\ESA22.1\User\GraphicTemp						
PROGRAM DIRECTORIES*							
Show directories for	User Templates 🔹 👻						
Directories	* × 🛧 🗸						
C:\Users	and the second second						

• Now you can easily open this file from the project browser:

🚹 New project	New Project from Template					
📑 New from template 🖪	Enter search term: Search for project					
	Name	Date Size				
Recent projects	User Templates	1/1/1601 1:00:(
Browse	Reinforcement beam parametric.esa	9/29/2023 1:32 964 k				
	▲ System Templates	1/1/1601 1:00:(
🕄 Tutorials	Standard templates	3/27/2023 4:43				
	Eurocode	3/27/2023 4:43				
Learning Centre	▷ 🔯 IBC	3/27/2023 4:43				
	A Rarametric projects	3/27/2023 4:43				
	Concrete Structures	3/27/2023 4:43				
	User templates	7/21/2023 4:05				

And everytime you do so you will be asked what you want to set as values for the parameters:

Project						Х
Geometry	Cross section	Reinforcement	Loads	Project	settings	
		span [m] 3,00 span [m] 2,00			SAMPLE PICTURE	
유 닝						
				ОК	Cancel Ap	ply

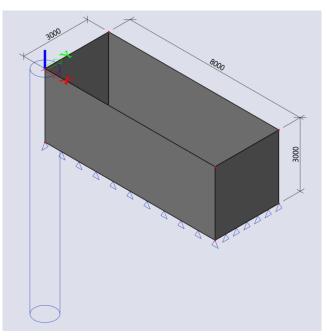
EXAMPLE 7: Water and ground pressure from soil

Example: "Soil parametric.esa"

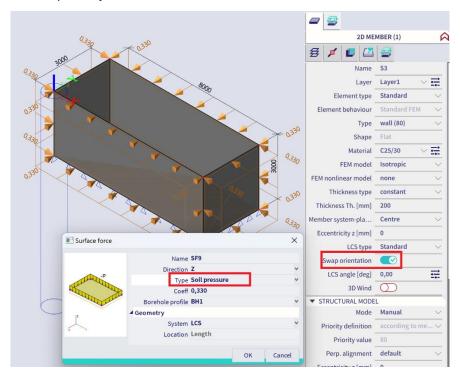
Project data:

- Structure type: General XYZ
- Materials: Concrete C30/37
- Functionality: 'Parametric Input'

Create a rectangular concrete basement with 2D elements and below dimensions. Add a borehole profile on coordinates "0 0 0":



We are going to let the water pressure and soil pressure depend on the height of both the geological profile aswell as the water level. Create a load case for each and apply soil and water pressure. Make sure all loads are pointing inwards and possibly switch orientation if this is not the case:



• Go to "Libraries" > "Subsoil and foundation" > "Subsoils" in the main menu and add a number of subsoils to the database with different values for C1z. Add one "Dummy" subsoil on top of the list and enable the "Selector" option, this soil will serve as our toggle switch:

Subsoils		×
📑 📲 🖾 📴 🐟	💊 🗖 음 🖬	All 🗸 🔨
SELECTOR - NEN 6740	Name	SELECTOR
Gravel/Slightly silty/Mo	Selector switch	
Gravel/Very silty/Moder	Description	NEN 6740
Sand/Clean/Moderate	C1x [MN/m^3]	1,0000e+00
Loam/Slightly sandy/M Clay/Clean/Moderate	C1y [MN/m^3]	1,0000e+00
Clay/Slightly sandy/Mo	C1z	Flexible
Clay/Organic/Moderate	Stiffness [MN/m^3	1,0000e+00
Peat/Moderate preload	C2x [MN/m]	0,0000e+00
New Insert Edit	Delete	Close

Go to "Libraries" > "Subsoil and foundation" > "Geologic profiles" from the main menu and add a
number of profiles. In this example we are going use these profiles to switch between water levels so
therefor use the same ground properties but change height of water level for each profile. Add one
"Dummy" profile on top of the list and enable the "Selector" option, this profile will serve as our
toggle switch:

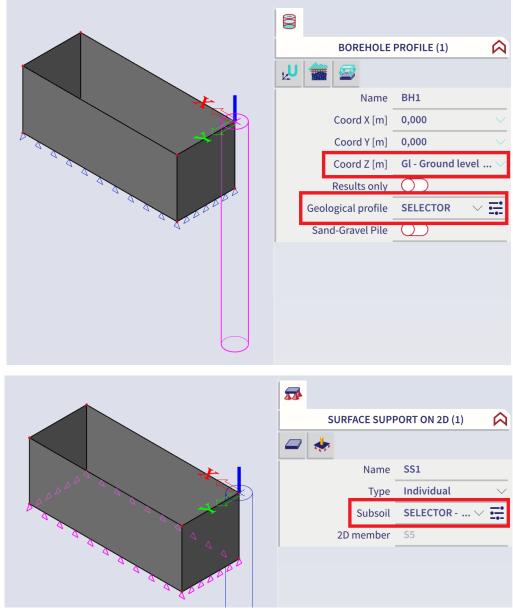
El Geologic profiles	X
📑 📲 🖾 🕩 🗟 🐟 🗢 🛅 🖨 🖸 All	• T
SELECTOR	
GP1 - water 0	
GP1 - water -1	
GP1 - water -2	
GP1 - water -3	
	Thickness = $10.00[m]$, Edef
Name SELECTOR	_
Selector switch 🗸	
Water level [m] 0,000	
Non-compressible	
▲ Layers	
▷ 1	
New Insert Edit Delete	Close

• Go to "Libraries" > "Tools" > "Parameters" and define the below parameters:

Parameters				×	🔳 Par	ameters					×	🔳 Para	ameters					×
📑 📲 🗹 📴 🖉	All	×]	7		:	🖸 🕩		All		• T		et -8	🖸 🖡		All	,	• T	
Gl - Ground level	Na	me Gl			Gl - Gro	und level			Name	Sub		Gl - Gro	und level			Name	Sup	
Sub - Geological profile	T	pe Len	gth			eological			Туре	Library	~		eological p			Туре	Library	~
Sup - Surface support	Descript	ion Gro	und leve	l.	Sup - Su	urface sup	port	Des	scription	Geological	profile	Sup - Su	irface sup	port	Desc	ription	Surface s	apport
	Evaluat	ion Valu	ie	~					Library	Geologic p	rofiles 🗸					Library	Subsoils	~
	Value	m] 0,00)						Value	SELECTOR	~					Value	SELECTO	R - NEN 🛩
	Use rai	nge						Alt	ternative	GP1 - wate	r0 🗸				Alte	rnative	Clay/Orga	nic/Moc
	Actions							Select Alt	ernatives						Select Alter	rnative		
	Actions		Valida	te >>>				Alternat	tive no. 1	GP1 - wate	r 0				Alternativ	ve no. 1	Gravel/Sli	ghtly silt
								Alternat	tive no. 2	GP1 - wate	r -1				Alternativ	ve no. 2	Gravel/Ve	ry silty/№
New Insert Edit	Delete			Close				Alternat	tive no. 3	GP1 - wate	r -2				Alternativ	ve no. 3	Sand/Clea	n/Moder
								Alternat	tive no. 4	GP1 - wate	r -3				Alternativ	ve no. 4	Loam/Slig	htly sand
								Actions							Alternativ	/e no. 5	Clay/Clea	n/Modera
										Valid	ate >>>				Alternativ	/e no. 6	Clay/Sligh	itly sandy
					New	Insert	Edit	Delete			Close				Alternativ	/e no. 7	Clay/Orga	nic/Mode
					New		Luit	Delete			close				Alternativ	/e no. 8	Peat/Mod	erate pre
															Actions			
																	Vali	date >>>
												New	Insert	Edit	Delete			Close

For the soil and geological profiles chose all the options from the list you defined under "select alternative".

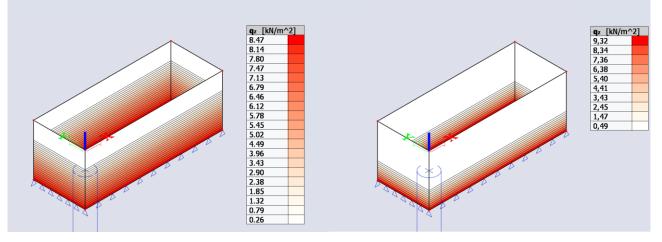
• Now apply the correct parameters to the variables in the model as shown below:



- Go to "Libraries" > "Tools" > "Parameters template set" and define one set of parameters.
- Go to "File" > "Template manager" and set the below values for the parameters:

Ground parameters

Gl - Ground level [m] **-1,00** Sub - Geological profile SELECTOR - GP1 - water -1 ... Sup - Surface support SELECTOR - NEN 6740 ... • Run the calculation, go to "Results" > "Surface loads" from the main menu and verify the ground load starts at one meter from the top and the water load starts at two meters from the top:



EXAMPLE 8: Layers

Example: "layers parametric.esa"

Project data:

- Structure type: frame XZ
- Materials: steel S235
- Functionality: 'Parametric Input'

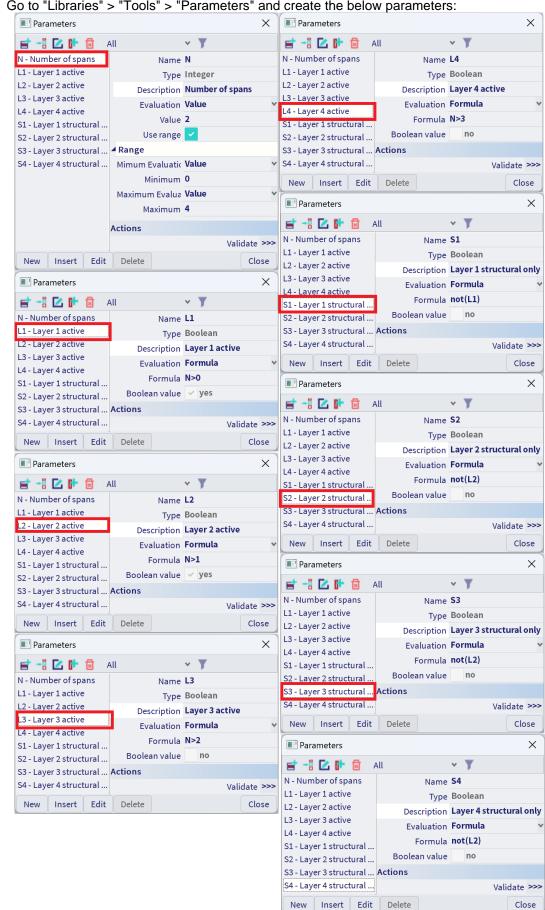
Create 4 beams supported on hinges:



We are going to change the amount of spans by using both the layer visibility and "structural layer only" property.

Therefor make 4 different layers, one for each span and assign each beam to a different span layer:

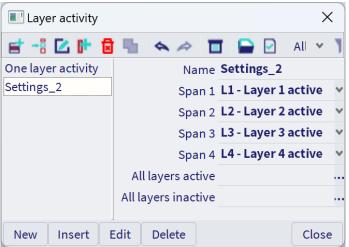




Go to "Libraries" > "Tools" > "Parameters" and create the below parameters:

With the Boolean for the layers we are changing the visibility, with the Boolean for the structural type we are going to take a certain beam into account in the analysis or not.

• Go to "View" > "Visibility" > "By Layers" from the main menu and apply the layer parameter to the activity toggle switch:



• Go to "Libraries" > "Layers" from the main menu and link the "structural only layer" toggle switch to the corresponding Boolean parameter:

Layers			×
et -: 🖸 🕩 🗟 🕤 🗖 👘	All	• T	
Span 1	L1 - Layer 1 act	Name	Span 1
Span 2	L2 - Layer 2 act	Comment	
Span 3	L3 - Layer 3 act	Colour	
Span 4	L4 - Layer 4 act		S1 - Layer 1 structural o
			L1 - Layer 1 active 🛛 🗸
New Insert Edit Delete			Close
Layers			×
	All	• T	
Span 1	L1 - Layer 1 act	Name	Span 2
Span 2	L2 - Layer 2 act	Comment	
Span 3	L3 - Layer 3 act	Colour	
Span 4	L4 - Layer 4 act		S2 - Layer 2 structural o
		Current used activ	L2 - Layer 2 active 🔹
New Insert Edit Delete			Close
Layers			×
et -: 🖸 🕩 🗟 🐁 🗖	All	• T	
Span 1	L1 - Layer 1 act	Name	Span 3
Span 2	L2 - Layer 2 act	Comment	
Span 3	L3 - Layer 3 act	Colour	
Span 4	L4 - Layer 4 act	Structural model (S3 - Layer 3 structural o
			L3 - Layer 3 active 🛛 🗸
New Insert Edit Delete			Close
Layers			×
Layers			~
	All	u 🛡	
	All	* T	6
Span 1	L1 - Layer 1 act		Span 4
Span 1 Span 2	L1 - Layer 1 act L2 - Layer 2 act	Comment	
Span 1 Span 2 Span 3	L1 - Layer 1 act L2 - Layer 2 act L3 - Layer 3 act	Comment Colour	
Span 1 Span 2	L1 - Layer 1 act L2 - Layer 2 act	Comment Colour Structural model د	S4 - Layer 4 structural o
Span 1 Span 2 Span 3	L1 - Layer 1 act L2 - Layer 2 act L3 - Layer 3 act	Comment Colour Structural model د	



EXAMPLE 9: Steel hall

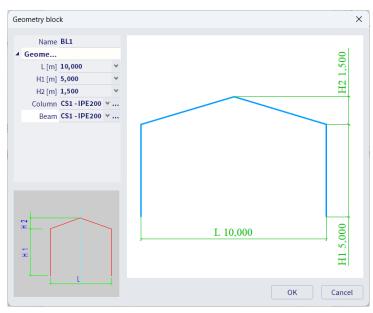
Example: "Steel hall parametric.esa"

Project data:

- Structure type: general XYZ
- Materials: steel S235
- Functionality: 'Parametric Input'

We are going to create a steel hall with a varying amount of frames using the same principle as we used in the previous example.

Create a frame with the below parameters (search for "catalogue blocks" in the command line and chose for frame 2D):

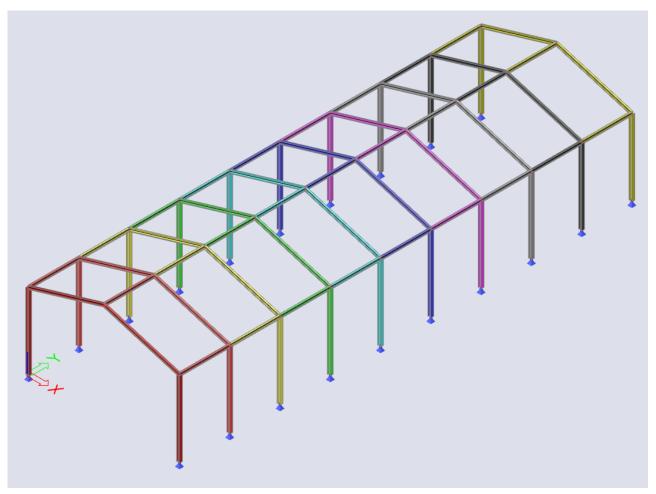


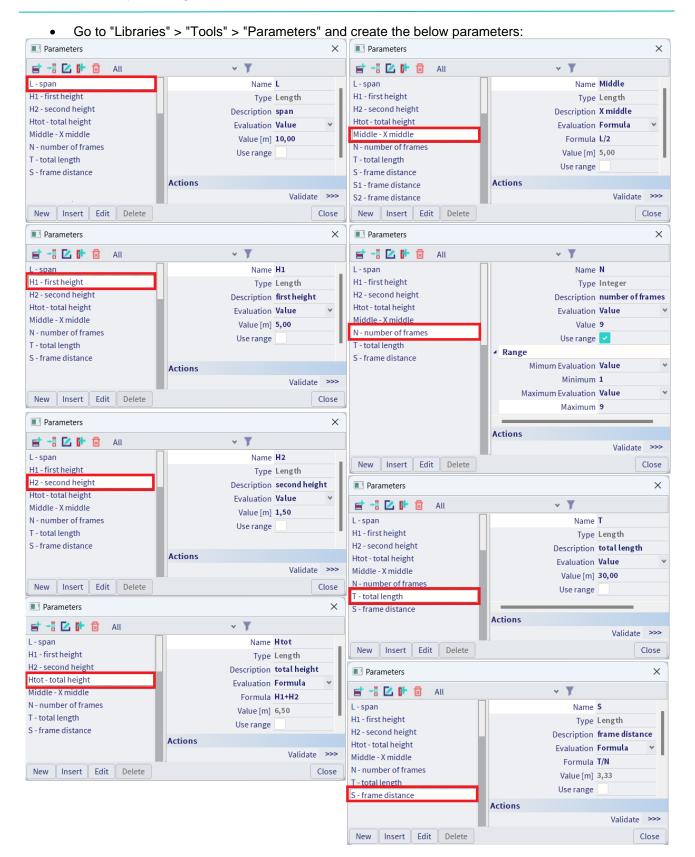
Afterwards copy the frame a number of times with the multicopy tool, note that the amount of copies you chose here will be the maximum amount of frames the hall will ever contain.

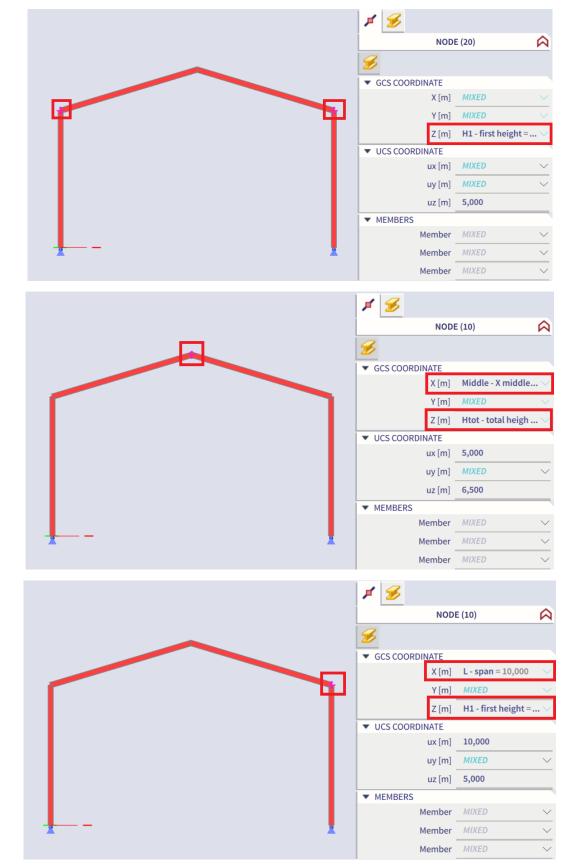
Also select the top nodes within the multicopy and enable "connect selected nodes with new beams":

	₽										
MU			r of copies	10 +	Connect selected nodes with new beams						
- 4		M Inser	t the very last	сору	Copy additional data						
			CEVECTOR		HOW TO DEFINE THE DISTA	ANCE ?					
	=	Define o	distance by cu	rsor	between two copies						
	*	x	0,000	m	Member					×	:
		У	5	m		^	Type	beam (80)		~	
	A	z	0,000	m		$\langle \rangle$	Analysis model			¥	
	A	ROTATIO	ON		α	120	Cross-section	CS2 - HE2004	4	×	
	æ	rx	0,00	deg		J	Alpha [deg]	0,00			
	-	ry	0,00	deg	z		Member system-line at	Centre		~	
	<u>Å-</u>	rz	0,00	deg			ey [mm]				
	11				ez		ez [mm]			_	
	ŧ				i i vez			standard		×	
	_				ey	z i	LCS Rotation [deg]	o, oo standard		~	
	13							default		·	
	<u>~</u>				x	Y	Buckling	ucluure			
							. Section B				
	E								OK	Cancel	
	14										
1	A										
C pr	E)										
E	-										

The total structure should look something like this:







You can already assign "H1" and "Htot" tot the Z-coordinates of the roof and "L" and "Middle" to the X-coordinates of the frame:

- Go to "Libraries" > "Tools" > "Parameters" again and for each copy of a frame you create the below parameters:
 - One that calculates the Y-distance of the frame:

Parameters		×
📑 📲 🔀 📴 🛛 All	• T	
L - span	Name	\$1
H1 - first height	Туре	Length
H2 - second height	Description	frame distance
Htot - total height	Evaluation	Formula 🗸 🗸
Middle - X middle	Formula	S*1
N - number of frames	Value [m]	3.33
T - total length	Use range	
S - frame distance	oscrange	
S1 - frame distance		
S2 - frame distance	Actions	
S3 - frame distance		Validate >>>
New Insert Edit Delete		Close

• One that decides wether the layer should be active or not (in this case as opposed to the previous example we test if the length of the hall is smaller than the total length):

Parameters		×
📑 📲 🔀 🕩 🗟 🛛 All	• T	
S8 - frame distance	Name	A4
S9 - frame distance	Туре	Boolean
A1 - activity L1	Description	activity L4
A2 - activity L2	Evaluation	Formula 🗸 🗸
A3 - activity L3	Formula	\$4<=T
A4 - activity L4	Boolean value	✓ yes
A5 - activity L5		
A6 - activity L6		
A7 - activity L7		
A8 - activity L8	Actions	
A9 - activity L9		Validate >>>
New Insert Edit Delete		Close

• One that decides wether the layer should be of type "structural layer only" or not (this should give the opposite Boolean and the previous one):

Parameters		×
📑 📲 🔽 🕩 🖬 🛛 All	× Ţ	
A8 - activity L8	Name	C8
A9 - activity L9	Туре	Boolean 🗸
C1 - model L1	Description	model L8
C2 - model L2	Evaluation	Formula 🗸 🗸
C3 - model L3	Formula	\$8>T
C4 - model L4	Boolean value	no
C5 - model L5	Boolean value	
C6 - model L6		
C7 - model L7		
C8 - model L8	Actions	
C9 - model L9		Validate >>>
New Insert Edit Delete		Close

• 1	low for ea	ach frame	e assign	the corre	ect param	neter to th	ne Y-coo	rdinate of	f the co	orrespon	ding	g fran	ne:
										1			
											NOD	E (5)	
										ቆ 💋			
				1						▼ GCS COORDIN	ATE		
				-							X [m]	MIXED	
											Y [m]	S4 - frame	distan \vee
											Z [m]	MIXED	\sim
										 UCS COORDINA 	ATE		
										L	ix [m]	MIXED	\sim
										L	y [m]	13,333	
										L	ız [m]	MIXED	\sim
										 MEMBERS 			
T	1 1			T	I)			L X		Ме	mber	MIXED	\sim

• Go to "View" > "Visibility" > "By layers" and set the proper activity parameter to the proper layer:

Layer activity		×
🖶 📲 🗹 🕪 🗟 🖷 🐟 🛷 🛅 🖨	All	• T
One layer activity	Name	Settings_2
Settings_2	L1	yes
	L2 .	A1 - a ctivity L1
	L3	A2 - a ctivity L2
	L4	A3 - a ctivity L3
	L5	A4 - a ctivity L4
	L6	A5 - a ctivity L5
	L7	A6 - a ctivity L6
	L8	A7 - activity L7
	L9	A8 - a ctivity L8
	L10	A9 - a ctivity L9
	All layers active	
	All layers inactive	
New Insert Edit Delete		Close

 Finally go to "Libraries" > "Layers" and set the proper parameter for the "structural model only" option:

Layers			×
et -: 🖸 🕩 🕯	ali 🗖 🖬	~ 7	
L1	yes	Name L10	
L2	A1 - activity L1	Comment	
L3	A2 - activity L2	Colour	
L4	A3 - activity L3	Structural model only C9-model L9	~
L5	A4 - activity L4	Current used activity A9 - activity L9	×
L6	A5 - activity L5		
L7	A6 - activity L6		
L8	A7 - activity L7		
L9	A8 - activity L8		
L10	A9 - activity L9		
New Insert I	Edit Delete		Close

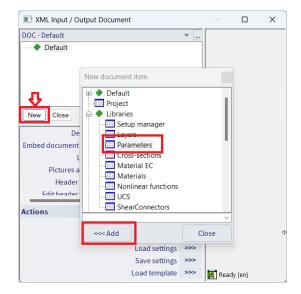
XML

SCIA Engineer allows for the exchange of data with third-party applications through the popular and powerful XML format. Moreover, XML format can be used to develop tailor-made applications that use SCIA Engineer as a "hidden" engine working on the background and performing calculations of company-specific problems.

The XML file editor is very similar to the Document of SCIA Engineer. The principle is that the user defines tables describing individual entities of the SCIA Engineer projects and there order. This table-form can be easily previewed (it is in fact identical to the standard SCIA Engineer document). When ready, the final XML file contents can be transformed into the real XML format through the export function.

Open example 9 again: "Steel hall parametric.esa".

Go to "File" > "Export to" > "XML" from the main menu and close the next window where you are asked to open a XML definition template (we are starting from scratch so this is not required now). You'll then land in a window where you can set up an XML definition of the project you created. We are just going to add the parameters of the project to the XML format:

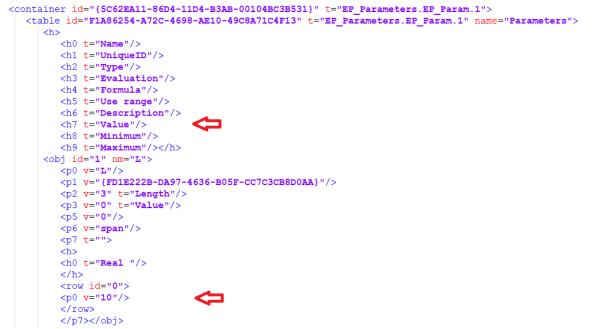


Once added click on the export button and save the file to a local destination:

I XML Input / Output Document						×
DOC - Default 🗸 🗸	📭 🖉	📑 🗖 📔 🕂 🔲 💻 100 %	🗹 🖬	📕 default		v 🛄
◆ Default Parameters		Export	-			
	Padrice	UniquelD	Туре	Evaluation	Form ula	Us ran
		(FD1E222B-DA97-4636-B05F-CC7C3CB8D0AA)	Length	Value		false
New Close						
Name Parameters	H1	{CCF0E86D-2B31-4411-95F3-75A7ABF2C7DA}	Length	Value		false
Caption Parameters						
Joint tables						
Filter All	* H2	(8280 2DCD-8 5AB-45 6A-BB 99-DBA EA7 689212)	Length	Value		false
	112	1000,610,010,010,000,000,000,000,000,000	Cengui	Valle		1050
	Htot	(A02D0F81-99F9-4F87-8175-98F0SDEC1A7D)	Length	Formula	H1+H2	faise
	Middle	(A24AE A80-08EB-48B8-A3D5-933E2C8BEFE6)	Length	Formula	L/2	false
Actions			1	1	1	1
Refresh >>	> 📕 Read	y [en]				

Open the text file with any text editor.

Here you can find the XML definition of all parameters. Change "h7" of any parameter, which is the actual value, and save the file:



If you now update the Scia project with this information you will see the parameter has been changed. You do that with "File" > "Update from" > "XML" from the main menu.

The above approach you can use to design your own custom tools which change the XML format of the representation of any of your analytical projects. Possibly provided with parameters.

User blocks & project templates

User Blocks

SCIA Engineer enables the user to make a library of his/her projects that are used over and over again. These projects may be at any time included into a newly created project or appended to an earlier created and currently edited project.

The projects in this user-created library are called User blocks and the library is called User block library.

We will again use example 9: ""Steel hall parametric.esa".

 Open the file and save it as a user block by going to "File" > "Save as" and saving it in the folder your chose for saving user blocks. Which one that is you can find in the global setup:

Global UI settin	igs					\times
Environment Templates & directories		Other	Debugging to	ols		
TEMPLATES						
	Print picture path	phicTe	mplates\A4_Po	rtrait_SciaLo	go.epd	
Overview drawings manager		C:\Use	rs\	0.1 (her fir	gite Ter	
PROGRAM DIF	RECTORIES*					
	Show directories for	User b	lock libraries			~
Directories				*	×	¥
C:\Users\	tijn@nebrice_SC#.nc@n	cuments	Userl	Blocks\		
						_
*These	settings cannot be edited wi	hile a pro	oject is opened			
				OK	Cance	el

• Create a new general XYZ project and go to "User blocks" in the input panel:

INPUT PANEL			All workstations	\sim
All categories	\sim	0	All tags	\sim
Opening on panel	4	R		
 IMPORT & BLOCKS 				
Catalog blocks				
E User blocks				
Predefined shapes				
Import project from esa file				
Import DWG, DXF, VRML97				
▼ PRESTRESSING				
Post-tensioned tendon				

User blocks	>
<mark></mark> User library	Steel hall
	Chercostic Delhie 308
	OK Cancel

There you should now find the parametric project you just saved in this folder:

Next a window appears where you can change the parameter values in before importing the project:

Parameters of block	×
Geometry Loads	
L - span [m] 10,00 H1 - first height [m] 5,00 H2 - second height [m] 1,50 T - total length [m] 20,00 N - number of frames 4	SAMPLE PICTURE
Refresh	
K.	
	OK Cancel Apply

Project templates

In practice it may quite often happen that some elements are used in every project. For example, material types, cross-sections, predefined loads, and even parts of a structure may be the same in various projects. Therefore, it would be efficient, if the user could store the repetitious elements aside and load them quickly into every new project.

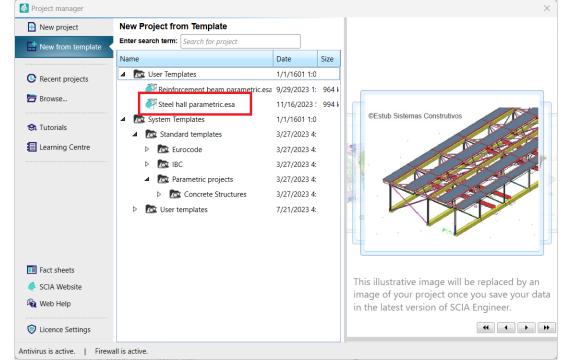
In SCIA Engineer this may be achieved via templates. Generally speaking, a template is an ordinary project that holds required information and is saved in a special way.

We will again use example 9: ""Steel hall parametric.esa".

• Open the file and save it as a template file by going to "File" > "Save as" and saving it in the folder your chose for saving template files. Which one that is you can find in the global setup:

Global UI settings Environment Templates & directories Other Debugging tools TEMPLATES Print picture path phicTemplates\A4_Portrait_SciaLogo.epc	×
TEMPLATES	
Print picture path phicTemplates\A4_Portrait_SciaLogo.epc	
	1
Overview drawings manager	
PROGRAM DIRECTORIES*	
Show directories for User Templates	٧
Directories 🔹 🗙	h 4
C:\Users\	
🗥 *These settings cannot be edited while a project is opened	
OK Car	ncel

• Now close the file and go to "Project manager" from "File" in the main menu:



There you should now find the template project you just saved.

• Again, if you open a template which was set up in a parametric way a window appears before the project is opened that allows you to change the parameters. As opposed to user using blocks, the parameters are now kept within the project:

Project	×
Geometry Loads Project settings	
L - span [m] 10,00 H1 - first height [m] 5,00 H2 - second height [m] 1,50 T - total length [m] 30,00 N - number of frames 5	SAMPLE PICTURE
Refresh	
	OK Cancel Apply

Parameterizing - GENERAL

Types of parameters

Nothing	The parameter is not used.	
Integer	The parameter is used as an integer.	
Coefficient	icient The parameter is used as coefficient.	
Length	The parameter is used for definition of length in the model.	
Force	The parameter is used for definition of size of force load.	
Moment	The parameter is used for definition of size of moment load.	
Line load	The parameter is used for definition of size of line load.	
Surface load	The parameter is used for definition of size of surface load.	
Mass	The parameter is used for definition of size of masses.	
Line mass	The parameter is used for definition of size of line masses.	
Surface mass	The parameter is used for definition of size of surface masses.	
Cross-section length	The parameter is used for definition of length at cross-sections.	
Angle	The parameter is used for definition of angles.	
Relative	The parameter is used for definition of relative values.	
Cross-section rolled	The parameter is used for definition of cross-sections.	
Library	This parameter type can be used with any "library" item, i.e. any item that is selected from one of ESA PT's internal databases, such a materials, cross-sections, subsoil, reinforcement pattern, etc.	
Combination factor	Combination factors for load cases inserted into a combination.	
Relative humidity	applicable in the calculation of long term losses in prestress.	
Time (history)	Time of individual construnction stages on time-line.	
Stress	(i) Stress in concrete that can be defined in measured values when the Time Dependant Analysis is performed or	
	(ii) the initial stress of the strands for a strand pattern.	

When in doubt wether a certain property can be parameterized or not, you can try to create as many types of parameters as possible. If the property is something you can parametrizise the parameter will show as a dropdown list.

Possible formulae

-ta	Adds the given numbers / parameters	
	Subtracts the given numbers / parameters	
•	Multiplies the given numbers / parameters	
	Divides the given numbers / parameters	
	Modulo – gives the remainder after division of two numbers	
N HE	Raises the given number to a given power	
()	Putting individual members of the expression may change the priority of evaluation.	
sin(x)	Calculates the sine of parameter x	
cos(x)	Calculates the cosine of parameter $ imes$	
tan(x)	Calculates the tangent of parameter ×	
tg(x)	CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR	
arcsin(x)	Calculates the arcsine of parameter ×	
asin(x)		
arccos(x)	Calculates the arccosine of parameter ×	
acos(x)		
arctan(x)	Calculates the arctangent of parameter \times	
arctg(x)		
atan(x)		
atg(x)		
ln(x)	Calculates the natural logarithm of x.	
log(x)	Calculates log ₁₀ (x).	
exp(x)	Calculates the exponential e to the x-th power.	
sign(x)	Returns the sign of parameter x. Returns +1 for positive argument. Returns -1 for negative argument.	
sgn(x)		
sqrt(x)	Calculates the positive square root of parameter ×.	

Possible operators

М	"+"	ADD;
м	- <u>-</u>	SUB;
м	"*"	MUL;
м	"\\"	MOD;
М	"/"	DIV;
Ж	"^"	POW;
м	"<"	LESS;
м	"<="	LESS_OR_EQUAL;
м	"=="	EOUAL;
м	"<>"	NOT_EQUAL;
м	">="	EOUAL_OR_BIGGER;
м	">"	BIGGER;
м	"&&"	AND;
М	"11"	OR;
м	"^^"	XOR;

Example:

(W_S==1)*HW+(W_S==0)*(W-100)
 If W_S=1 then H_BL=HW
 If W_S=0 then H_BL=HW-100

Name	H_BL
Туре	Length
Description	Höhe Borlochprofil
Evaluation	Formula
Formula	(W_S==1)*HW+(W_S==0)*(HW-100)
Value [m]	-00,000
Use range	